

What is claimed is:

1. A method for separating magnetic material from non-magnetic material, the method comprising:
 - 5 providing a container;
directing a slurry into the container through a slurry inlet, wherein the slurry comprises magnetic material and non-magnetic material;
using at least a medium to separate the magnetic material from the non-magnetic material, wherein a portion of the magnetic material is transported with
10 non-magnetic material along a path by at least the medium toward an overflow outlet; and
positioning a magnetic grid defining a plurality of openings in the path of the transported magnetic material, wherein the magnetic grid prevents at least a portion of the transported magnetic material from passing through the plurality of openings
15 to the overflow outlet.
2. The method according to claim 1, wherein the container extends along an axis from a lower region to an upper region, wherein the upper region is located proximate the overflow outlet, and further wherein the magnetic grid is positioned
20 orthogonal to the axis.
3. The method according to claim 1, wherein the magnetic grid comprises a permanently magnetized grid.
- 25 4. The method according to claim 1, wherein the magnetic grid generates a magnetic field within each opening of the plurality of openings, and further wherein the magnetic field within each opening of the plurality of openings is of a strength to prevent at least a portion of the transported magnetic material from entering the overflow outlet.

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5. The method according to claim 1, wherein the magnetic grid comprises one or more layers of magnetic sheet strips defining the plurality of openings.
6. The method according to claim 5, wherein the method further comprises
5 controlling the magnetic field in each opening of the plurality of openings by increasing or decreasing the number of layers of magnetic sheet strips of the magnetic grid.
7. The method according to claim 1, wherein each opening of the plurality of
10 openings in the magnetic grid comprises a rectangular shape.
8. The method according to claim 7, wherein each opening of the plurality of openings in the magnetic grid comprises a square shape.
- 15 9. The method according to claim 1, wherein the method further comprises coating at least a portion of the magnetic grid with a portion of the transported magnetic material.
10. The method according to claim 1, wherein the magnetic material comprises a
20 plurality of magnetite particles, wherein the magnetic grid prevents at least a portion of the magnetite particles from entering the overflow outlet, and further wherein at least a portion of the plurality of magnetite particles prevented from entering the overflow outlet comprises a particle diameter that is less than or equal to 25 μm .
- 25 11. The method according to claim 1, wherein at least the container is a component of a hydroseparator system, wherein the container extends along an axis from a lower region to an upper region, wherein the overflow outlet is located proximate the upper region, wherein the hydroseparator system further comprises an underflow outlet located proximate the lower region of the container for discharging
30 separated magnetic material, and further wherein using the medium to separate the

magnetic material from the non-magnetic material comprises using at least a liquid as the medium to separate the magnetic material from the non-magnetic material.

12. The method according to claim 11, wherein positioning the magnetic grid
5 further comprises positioning the magnetic grid within the slurry in the container.

13. The method according to claim 1, wherein the medium comprises at least one of a gas or a liquid.

10 14. The method according to claim 1, wherein the method further comprises mixing the slurry with the medium before the slurry is directed into the container.

15. The method according to claim 1, wherein the method further comprises:
providing an external magnetizing coil; and
15 directing the slurry through the external magnetizing coil before the slurry is directed into the container.

16. The method according to claim 1, wherein at least the container is a component of a flotation system, wherein the container extends along an axis from a
20 lower region to an upper region, wherein the overflow outlet is located proximate the upper region, and wherein the flotation system further comprises an underflow outlet located proximate the lower region of the container for discharging separated magnetic material, and further wherein using the medium to separate the magnetic material from the non-magnetic material comprises using a gas as the medium to
25 separate the magnetic material from the non-magnetic material.

17. The method according to claim 16, wherein the method further comprises bubbling the gas to generate a plurality of bubbles, wherein the portion of magnetic material and at least a portion of non-magnetic material is transported toward the
30 upper region of the container by the plurality of bubbles.

18. The method according to claim 17, wherein bubbling the gas generates a froth proximate the upper region of the container, and further wherein the froth defines a boundary with the slurry in the container, wherein positioning the
5 magnetic grid further comprises positioning the magnetic grid proximate the boundary.

19. A separation apparatus for separating magnetic material from non-magnetic material, the apparatus comprising:
10 a container, the container comprising a slurry inlet configured to provide a slurry into the container and an overflow outlet; and
a magnetic grid positioned in the container between the slurry inlet and the overflow outlet, wherein the magnetic grid defines a plurality of openings, and further wherein the magnetic grid is configured to generate a magnetic field in each
15 opening of the plurality of openings.

20. The apparatus according to claim 19, wherein the magnetic grid comprises one or more layers of magnetic sheet strips.

20 21. The apparatus according to claim 19, wherein the magnetic grid comprises a permanently magnetized grid.

22. The apparatus according to claim 19, wherein the magnetic grid generates a magnetic field, wherein the magnetic field within each opening of the plurality of
25 openings is of a sufficient strength to prevent at least a portion of magnetic material of a slurry provided in the container from entering the overflow outlet when a separation process is employed.

23. The apparatus according to claim 19, wherein each opening of the plurality
30 of openings of the magnetic grid comprises a rectangular shape.

24. The apparatus according to claim 23, wherein each opening of the plurality of openings of the magnetic grid comprises a square shape.

5 25. The apparatus according to claim 19, wherein the container further comprises a medium inlet configured to receive a medium for use in separating magnetic material from non-magnetic material.

10 26. The apparatus according to claim 19, wherein the container extends along an axis from a lower region of the container to an upper region of the container, and further wherein the magnetic grid is positioned proximate the upper region of the container orthogonal to the axis.

15 27. The apparatus according to claim 19, wherein at least the container is a component of a hydroseparator, and further wherein the magnetic grid is positioned below the overflow outlet.

20 28. The apparatus according to claim 19, wherein the apparatus further comprises a magnetizing coil configured to magnetize the slurry external to the container.

25 29. The apparatus according to claim 26, wherein at least the container is a component of a flotation system, wherein the flotation system is configured to generate a froth proximate the upper region of the container when a separation process is employed, wherein the froth defines a boundary with the slurry in the container when a separation process is employed, and further wherein the magnetic grid is positioned proximate the boundary.

30 30. A hydroseparator system for separating magnetic material from non-magnetic material, the system comprising:

a container extending along an axis from a lower region to an upper region,
the container comprising:

a slurry inlet configured to provide a slurry into the container;

an overflow outlet located proximate the upper region of the

5 container;

an underflow outlet located proximate the lower region of the
container configured to discharge separated magnetic material; and

a fluid inlet configured to provide at least a liquid into the container,
wherein the liquid is used in separating the magnetic material from the non-
10 magnetic material; and

a magnetic grid positioned in the container between the slurry inlet and the
overflow outlet, wherein the magnetic grid defines a plurality of openings, and
further wherein the magnetic grid is used to generate a magnetic field in each
opening of the plurality of openings.

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31. The system according to claim 30, wherein the magnetic grid is positioned
orthogonal to the axis.

32. The system according to claim 30, wherein the magnetic grid comprises one
20 or more layers of magnetic sheet strips.

33. The system according to claim 30, wherein the magnetic grid comprises a
permanently magnetic grid.

25 34. The system according to claim 30, wherein the magnetic grid generates a
magnetic field, wherein the magnetic field within each opening of the plurality of
openings is of a sufficient strength to prevent at least a portion of magnetic material
provided in the container during a separation process from entering the overflow
outlet when a separation process is employed.

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35. The system according to claim 30, wherein each opening of the plurality of openings comprises a rectangular shape.

36. The system according to claim 35, wherein each opening of the plurality of openings comprises a square shape.

37. A flotation system for separating magnetic material from non-magnetic material, the system comprising:

a container extending along an axis from a lower region to an upper region,
the container comprising:
a slurry inlet configured to provide a slurry into the container;
an overflow outlet located proximate the upper region of the container;
an underflow outlet located proximate the lower region of the container configured to discharge magnetic material; and
a gas inlet located proximate the lower region of the container, the gas inlet configured to receive a gas;
a bubble generation assembly positioned in the container, the bubble generation assembly configured to generate a plurality of bubbles using the gas; and
a magnetic grid positioned in the container between the slurry inlet and the overflow outlet, wherein the magnetic grid defines a plurality of openings, and further wherein the magnetic grid is used to generate a magnetic field in each opening of the plurality of openings.

38. The system according to claim 37, wherein the magnetic grid is orthogonal to the axis.

39. The system according to claim 37, wherein the magnetic grid comprises one or more layers of magnetic sheet strips.

40. The system according to claim 37, wherein the magnetic grid comprises a permanently magnetic grid.

5 41. The system according to claim 37, wherein the magnetic grid generates a magnetic field, wherein the magnetic field within each opening of the plurality of openings is of a sufficient strength to prevent at least a portion of magnetic material provided in the container when a separation process is employed from entering the overflow outlet.

10 42. The system according to claim 37, wherein each opening of the plurality of openings comprises a rectangular shape.

43. The system according to claim 42, wherein each opening of the plurality of openings comprises a square shape.

15 44. The system according to claim 37, wherein the bubble generation assembly is configured to generate a froth proximate the upper region of the container when a separation process is employed, wherein the froth defines a boundary with the slurry in the container when a separation process is employed, and further wherein the
20 magnetic grid is positioned proximate the boundary.